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ABSTRACT

Economists agree neither on the means for assessing education's contribution to the growth of productivity in the national economy nor on the role of education in the recent slowdown in productivity growth. Consequently, neither economists nor educators can confidently recommend a set of policies that will clearly lead to increases in education's contribution to productivity growth. In response to this need, the National Institute of Education (NIE) has begun a research program to explore the links between education and productivity, to develop improved methodology for conducting research in the field, and to examine a range of policy alternatives for increasing education's contribution to productivity growth. As a first step in addressing these research problems and policy issues, the NIE has commissioned six papers and plans to hold a conference in 1982 on education's contribution to productivity. Titles of the papers commissioned include "New Research Approaches to Measuring the Impact of Education on Productivity: The Growth Accounting Framework," by Dale Jorgenson; "Guides for the Development of Educational Policy: Equity, Efficiency, and the Measurement of Educational Quality," by W. Lee Hansen; "An Assessment of Existing Approaches to Measuring the Impact of Education on Productivity," by Finis Welch; "The Effects of Education on Productivity through Its Effects on Innovation and Research and Development," by Edwin Mansfield; "Education, Organization Design, and Productivity," by Edward E. Lawler, and "Private and Social Returns to Investment in Education and Implications for Productivity Growth," by Robert H. Haveman and Barbara L. Wolfe. (MN)

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# EDUCATION, PRODUCTIVITY AND THE NATIONAL ECONOMY

A Research Initiative of the National Institute of Education

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Economists agree neither on the means of assessing education's contribution to the growth of productivity in the national economy nor on the role of education in the recent slowdown in productivity growth. Neither economists nor educators can confidently recommend a set of policies--in such policy areas as the level and distribution of educational spending, organizational changes in education, or tax structure--that will clearly lead to increases in education's contribution to productivity growth.

The National Institute of Education in response to this situation has begun a research program to explore the links between education and productivity, to develop improved methodology for conducting research in this field and to examine a range of policy alternatives for increasing education's contribution to productivity growth.

Assessing education's contribution to productivity

The rate of productivity growth in the U.S. economy has declined dramatically in recent years. Labor productivity grew at an average annual rate of 2.6 percent a year from 1948 to 1968 in the nonfarm business sector of the economy. After 1968, productivity growth declined markedly. During the middle and late 1970s, productivity growth was less than one percent a year.[1]

1. Martin Neil Baily, "The Productivity Growth Slowdown and Capital Accumulation," American Economic Review, Vol. 71, No. 2 (May 1981), p. 326.

Many economists believed, in the 1960s and early 1970s, that education was a major contributor to the high productivity growth rate in the post-World War II period. For example, Edward Denison concluded that during the period 1964-69 education accounted for .49 percentage points, out of a total of 1.85 percentage points, of the increase in labor prouductivity.[2]

More recent research on the role of education in productivity growth, and education's role in the slowdown in productivity growth, provides few settled answers and raises many questions. In a recent study, Denison specifically addressed the issue of accounting for the productivity decline. Analyzing the period 1973-76, he found that labor productivity fell five-tenths of a percentage point per year. Nonetheless, improvements in the quality of labor due to education contributed a positive nine-tenths of a point to annual growth in labor productivity. This large positive source of productivity growth was of course offset by other negative sources, most of which have not been clearly identified or measured.[3] Denison wrote, "what happened is, to be blunt, a mystery."[4] Denison's viewpoint is shared by a number of other respected economists.[5]

2. Edward Denison, Accounting for United States Economic Growth, 1929-1969 (Washington, D.C.: Brookings, 1974), p. 120.

3. Edward Denison, Accounting for Slower Economic Growth: The United States in the 1970s (Washington, D.C.: Brookings, 1979), pp. 2, 94.

4. Denison, Slower Economic Growth, p. 4.

5. Shlomo Maital and Noah M. Meltz, eds., Lagging Productivity Growth: Causes and Remedies (Cambridge, Mass.: Ballinger, 1980), p. 274.

Analysts of education's contribution to productivity growth have had to face a number of critical methodological problems, which remain unresolved despite (in many cases) a good deal of effort. The following are among the most critical problems:

-- developing improved methods of calculating the economic returns to education.

-- determining whether the statistical link between education and earnings is due more to the productivity of education than to employers' use of education as a credential in hiring and promotion decisions.

-- determining whether the quality of education has declined in recent years.

-- examining whether the productivity of the education system itself has recently declined and obtaining appropriate prices for inputs and outputs in education, so as to measure productivity trends in education.

-- determining whether measures of productivity growth should be altered to take account of social as well as private returns to education and exploring the implications of this issue for the definition of productivity.

-- examining the extent to which improvements in the organization of the workplace can increase education's contribution to productivity.

-- determining whether education's impact on productivity can be measured solely by capturing its effects on the quality of the labor input or whether it also affects productivity in other ways--such as improving the efficiency of research and development activities--that can and should be separately measured.

-- examining the implications of the fact that education and productivity are causally interrelated: changes in the amount or quality of educational activity can cause a decline in productivity growth, but a productivity slowdown resulting from events elsewhere in the economy can diminish education's contribution to productivity, as conventionally measured.

Accompanying this set of analytic problems is a state of considerable uncertainty as to the implications for education policy of the current national effort to increase productivity growth. Arguments are being advanced for increased investment in vocational education, worker education, and science and technology education. Concurrently, the countervailing position, that the national effort to increase productivity requires dramatically less Federal

spending on education, is also being advanced. Few policy recommendations appear grounded in a broad or well-founded understanding of the role that education generally, or education of different types or occurring in different institutional settings, does in fact play in improving productivity.

The NIE research program

As a first step in addressing these critical research problems and policy issues, the National Institute of Education has commissioned six papers. These papers, which are being prepared by an outstanding group of economists and industrial psychologists, are to be completed in fiscal year 1982. The authors and their subjects are as follows:

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| Dale Jorgenson | New Research Approaches to Measuring the Impact of Education on Productivity: the Growth Accounting Framework |
| W. Lee Hansen | Guides for the Development of Educational Policy: Equity, Efficiency and the Measurement of Educational Quality |
| Finis Welch | An Assessment of Existing Approaches to Measuring the Impact of Education on Productivity |
| Edwin Mansfield | The Effects of Education on Productivity through Its Effects on Innovation and Research and Development |

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|---|---|
| Edward E. Lawler | Education, Organization Design, and Productivity |
| Robert H. Haveman and Barbara L. Wolfe | Private and Social Returns to Investment in Education and Implications for Productivity Growth |

Descriptions of these six studies are attached as an appendix to this statement.

NIE has also issued an RFP on the Returns to Investment in Postsecondary Education. The research called for by this RFP includes an effort to reexamine the evidence on whether the correlation between education and earnings is due to employer use of educational credentials as screening devices and need not be viewed, therefore, as strong evidence of the productivity of investment in education. This RFP is an important component of the NIE program of research in the productivity of investment in education.[6]

NIE also plans to hold a conference in 1982 on education's contribution to productivity. This conference will critically examine drafts of the six studies discussed above and develop priorities for further NIE initiatives in this research area, with special attention to the development of a policy-oriented research program. The conference and the final versions of the six papers, which are expected to be published, should also help other analysts gain new perspectives on the methodological and policy issues concerning the contribution of education to productivity. Participants in the conference will include the

6. While this RFP has been issued, it is not likely to be awarded in F.Y. 1982, due to budgetary constraints.

authors of the commissioned papers, other outstanding scholars, government officials, and business and labor union officials involved in research and development and worker training.

The conference is expected to consider the following policy questions:

-- Is the current national level of spending on education too large or too small from the viewpoint of enhancing productivity growth?

-- Would an alteration of the current distribution of educational spending and/or students--by major field of study, institutional setting, and type of occupation-specific education or training--contribute to productivity growth?

-- What changes in the interaction between educational institutions and businesses--including the offering of educational services to businesses and the exchange of faculty and funds between universities and employers--would enhance productivity?

-- How can educational policies contribute to a healthy U.S. balance of international payments position by preserving and improving the supposed U.S. comparative advantage in technology and knowledge-production generally?

-- Would alterations in the tax structure--including tax deductions for education and changes in personal tax rates designed to increase the returns to educational investment--improve productivity growth?

-- How can the organization of the workplace be altered to increase incentives for the acquisition and productive application of education and training?

-- Can education's contribution to productivity be increased without sacrificing the traditional American objective of equality of educational opportunity?

-- How can the research methods used by economists to measure education's contribution to productivity be altered so as to provide information useful for the development of policies for increasing education's contribution to productivity?

Following the planned conference on education and productivity, NIE will consider how its interests in this research area can best be developed, within the framework of prospective NIE budgets for F.Y. 1983 and F.Y. 1984. Further, the publication of a book presenting the results of their NIE-sponsored research should help other researchers in this field set their own priorities.

NIE has given consideration to conducting the later stages of this research program in collaboration with other research organizations. The partner organizations might be asked to implement a research program that NIE would design on the basis of recommendations made at the forthcoming conference. The research program would be designed, in large part, to yield recommendations for specific policy initiatives related to several or most of the policy issues outlined above. Further, it would be aimed at developing and implementing the suggestions for improved calculations of education's contribution to productivity that will be forthcoming from the six studies already commissioned. However, the main objective of the overall research effort will be to find practical means of increasing education's contribution to the growth of productivity in the national economy.

## APPENDIX: DESCRIPTIONS OF SIX NIE-SPONSORED STUDIES OF EDUCATION'S CONTRIBUTION TO PRODUCTIVITY

Dale Jorgenson
Department of Economics
Littauer Center 122
Harvard University
Cambridge, MA 02138
617/495-4661

NEW RESEARCH APPROACHES TO MEASURING THE IMPACT OF EDUCATION ON PRODUCTIVITY: THE GROWTH ACCOUNTING FRAMEWORK

This paper will develop improved analytic methods for measuring education's effect on productivity in light of the strengths and weaknesses of the past research, utilizing the growth accounting and productivity measurement approaches, on this problem. The paper will also suggest research approaches that might eventually lead to empirical results useful for policymaking. Further, it will examine the possibility of following more disaggregated approaches than have been utilized in past research; disaggregation might be in terms of specific occupations, fields of study, types of education (high school, college, graduate school, etc.). In general, the paper will explore the potential of the growth accounting and productivity measurement approaches for a more precise, policy-oriented, and disaggregated measurement of education's contribution to productivity.

The paper may also examine the criticisms of the growth accounting approach (and similar approaches to attributing output growth to education) that have been advanced by proponents of the screening hypothesis. It might also examine the means by which education has an impact on productivity.

W. Lee Hansen
Department of Economics
University of Wisconsin
6438 Social Science Building
Madison, WI 53706
608/262-6925

GUIDES FOR THE DEVELOPMENT OF EDUCATIONAL POLICY: EQUITY, EFFICIENCY AND THE MEASUREMENT OF EDUCATIONAL QUALITY

In the context of a study of education's influence on productivity growth, this paper will examine two issues: (1) the extent to which the objectives of productivity growth and equality of opportunity are complementary or competitive objectives in the formulation of educational policy and (2) the problem of defining and measuring the quality of education, in the context of an effort to better measure the contribution of education to productivity growth.

Policy options for increasing education's contribution to productivity growth should not be pursued without consideration of a traditional and vital objective of educational policy in this country: the role of education in increasing equality of opportunity. The paper might address, in formal analytic terms, the competitive or complementary character of the objectives of productivity growth and equality of opportunity. It might also develop a means of identifying the terms of trade-offs between these two objectives.

There has been much discussion of the possibility that the quality of education has declined in the last decade or so. Indeed, it is possible to argue that a decline in the quality of education has had a greater impact on productivity growth than any possible misallocation of resources among types of education. Therefore, this paper should also reconsider the old issue of how to define and measure the quality of education and, if possible, to suggest a synthesis of past approaches or a new approach to that issue. An appropriate definition of the quality of education depends partly on the uses to which the definition will be put. The research outlined here clearly involves a concern for improvement in the measurement of the contribution of people with specific amounts of education to productivity. However, the author of this paper may also wish to consider definitions of educational quality appropriate to improved measurement of the returns to investment in human capital or to study of the development and self-realization of human beings. It would also be tempting to examine the possibility that studies of performance on national tests would assist in the development of measures of trends in educational quality.

Finis Welch
Department of Economics
405 Hilgard
University of California
Los Angeles, CA 90024
213/825-1949

# AN ASSESSMENT OF EXISTING APPROACHES TO MEASURING THE IMPACT OF EDUCATION ON PRODUCTIVITY

This paper will examine the relative merits of human capital theory and growth accounting as approaches to determining the effect of education on productivity growth. It will examine the conditions under which one of these two approaches provides better estimates of education's effect than the other. The paper will also explore the means by which one or both of these two empirical approaches could be developed so as to facilitate research that might shed light on educational policy issues, such as changes in the level and distribution of educational resources that might increase productivity growth.

The paper will also examine the possibility of developing new methods of measuring productivity change in the education industry. This portion of the paper will explore means of determining appropriate prices for inputs and outputs in the education industry, along with other issues relating to productivity measurement in education. In this regard, too, attention will be given to policy issues, such as policies for improving the efficiency of resource distribution within and among educational institutions.

Edwin Mansfield
University of Pennsylvania
Department of Economics
3718 Locust Walk
Philadelphia, PA 19104
215/243-7788

THE EFFECTS OF EDUCATION ON PRODUCTIVITY THROUGH ITS EFFECTS ON INNOVATION AND RESEARCH AND DEVELOPMENT

In some studies, the direct effect of education on productivity growth is measured only through its effect on the quality of the labor input. In these studies, productivity also grows because of changes in a number of other variables, including some--such as "advances in knowledge"--whose influence is reflected only by the residual. Arguably, these advances in knowledge are strongly influenced by past education in the society at large. In other studies, researchers have examined the degree of association, across industries, between the measured rate of technological progress and industry expenditure on research and development. Considered together, these studies raise the question whether education's impact on productivity growth is completely captured by measuring its effects on the quality of labor.

The main purpose of this article is to address the issue of whether education affects productivity growth apart from its effects on the quality of the labor input and, if it does, how these additional influences may best be analyzed and, at some future time, measured. The paper should also examine the issue of whether changes in the organization of R&D activities--including the ways in which R&D is linked to user organizations, universities, and the government--might increase the impact of R&D on productivity growth.

The author of this article may wish to approach this problem by addressing one or more of the following topics: the possibility that education has large and potentially measurable external economies not captured through salaries and wages; whether R&D has been especially well organized in certain industries, such as agriculture, and whether such organization can be imitated by other industries; whether important lessons for the organization of education and R&D in the U.S. can be learned from the experience of other countries; whether prospective supplies of research scientists, engineers, and technicians are large enough so that productivity growth will not be greatly hampered by personnel "shortages;" as well as various issues related to the degree of cooperation or competition between private industry, universities, and government in the provision of R&D and the employment of training of researchers.

Edward E. Lawler
School of Business Administration
Bridge Hall, Room 200
University of Southern California
Los Angeles, CA 90007
213/743-8765

# EDUCATION, ORGANIZATION DESIGN, AND PRODUCTIVITY

Education does not contribute directly to productivity; its effect on productivity is mediated by the workplace, where people with differing amounts of education meet to produce goods and services. This workplace should not be treated as an empty box; it should be scrutinized. The workplace can be organized to provide employees with little or great incentive to produce efficiently; but just how large is this range--i.e., how much difference can the workplace make?

The main purposes of this article are to (1) describe methods of workplace organization that will increase (or, alternatively, maximize) productivity; (2) examine the implications of the most productive methods of organization for employer policies for education and training of employees; and (3) provide an analytic approach to measurement (or at least to assignment of an order of magnitude) of the contribution that more effective workplace organization could make (or has made in the recent past) to productivity growth.

An additional objective of this article relates to the issue of upward mobility; to what extent is it possible to provide poorly educated workers with additional education and well-defined job ladders for upward mobility without decreasing--or even while increasing--organizational efficiency?

Finally, the author of this article will probably wish to keep in mind the following questions: how does education actually affect productivity and how does the workplace make demands on skills provided by education and training and how, in turn, does it provide incentives for the acquisition and productive application of further education and training?

Robert H. Haveman
Department of Economics
Social Science Building
University of Wisconsin-Madison
Madison, Wisconsin 53706
608/263-7398

Barbara L. Wolfe
Institute for Research on Poverty
Social Science Building
University of Wisconsin-Madison
Madison, Wisconsin 53706
608/262-0345

**PRIVATE AND SOCIAL RETURNS TO INVESTMENT IN EDUCATION AND IMPLICATIONS FOR PRODUCTIVITY GROWTH**

This paper will examine the adequacy of current methods of determining the contribution of education to productivity growth from the perspective of possible divergences in private and social returns to investment in education. In particular, attempts to assess the impact of education on productivity growth through either the human capital or growth accounting frameworks may well capture all or almost all of the private returns to education and training, but may not capture all of the social returns. Hence, these approaches may lead to an incorrect estimation of the impact of education on productivity broadly defined.

A critical part of the paper will be a set of suggestions for new approaches to research on education's role in productivity growth that take into account the divergences, if any, in the private and social returns to investment in education. The paper will also examine the implications of the analysis for Federal and other government policies affecting education.

The paper may also explore topics related to the question of education's impact on the equality of the distribution of income or wealth.